Wiki as a Collaborative Learning Tool in a Language Arts Methods Class

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Abstract
The purpose of this study was to determine how contributing to a class wiki affected the learning of pre-service teachers enrolled in a language arts methods class. Participants included 37 preservice teachers enrolled in three sections of a field-based language arts methods class during two semesters. Data collection included online observations of the development of the wiki pages, students' reflections periodically posted in WebCT, final reflections, e-mail correspondence, interview transcripts, and researcher notes. Students' reflections indicate that contributing to the class wiki led to a deeper processing of the course content and was personally beneficial to the students in spite of persistent technology challenges.
(Keywords: collaborative learning, preservice teachers, technology integration, Web 2.0, wiki)

INTRODUCTION

Wikis are collaborative Web-based environments that allow multiple users to easily and quickly contribute content. They are dynamic, constantly changing Web pages where readers become authors and editors. Wikis are a Web 2.0 application, which allow for "distributed participation and collaboration" (Knobel & Lankshear, 2006, p. 81). These applications allow users to upload, build, and create content on the Web (Thomas, 2008). Web 2.0 reshapes the Web into global communities that anyone can join and where everyone can contribute (Parker & Chao, 2007; Tapscott & Williams, 2008). Members of these global communities collaborate as they create knowledge rather than just take in knowledge (Farabaugh, 2007; Mitchell, 2003). Extending these global communities into the classroom requires students to take responsibility for creating shared knowledge with their classmates.

Collaborative Learning and Wikis

Wikis harness a group's collaborative, creative energy to produce shared knowledge that benefits everyone (Evans, 2006) with at times unexpected results (Wells, 1999). In a collaborative online community, each student's ideas and knowledge are available and are a resource for everyone in the class (Hewitt & Scardamalia, 1998). "The posting and pooling of ideas generate sparks of creativity as others react, reflect, have their insights deepened or changed and, in turn, contribute something new" (Dearstyne, 2007, p. 30). As students combine their research, analyze it, and come to common understandings, a synergy develops (Achterman, 2006). Students discover that their collective answer is better than their individual answers (Evans) and that, as they produce new knowledge, they are advancing the collective knowledge of the group (Grant, 2006). Working together, students generate online materials that reflect what they have learned and show connections between their prior knowledge, the course content, and their personal experiences. During the collaborative work of creating a wiki, the community of users develops trust and gets to know one another (Evans). Collectively the users take ownership in the project, take pride in their work, and develop an appreciation of the contributions of the other users.

Effective Learning through Wikis

In classrooms, students may not have time to read and build on each other's work; however, in collaborative online environments, they are given this opportunity (Hewitt & Scardamalia, 1998). Research, discussions, and reflections started in the classroom can continue online. Reading and reflecting on course content outside the classroom increases students' understanding and retention (Ball & Washburn, 2001). As they contribute to a wiki, students are creating course resources and building course content in a shared space where they can add, delete, and revise their writing (Engstrom & Jewett, 2005; Evans, 2006; McPherson, 2006; Parker & Chao, 2007). Further, as students write their course content, they learn the material better than if they only read the textbook (Evans). Students do need to be reminded of copyright laws that prohibit copying and pasting content from other Web sites and the importance of giving credit for others' work (Belle, 2003). Also, students need to understand that the collaboratively created text is owned by all of the contributors (Botterbusch & Parker, 2008), and even though their writing is published once it appears on the wiki, it can still undergo revisions as others react and respond to the writing and make changes (Locke, 2006).

Giving students autonomy with regard to the scope and content of the wiki results in a better wiki (Richardson, 2006). However, students do need an organizational structure for the wiki (Engstrom & Jewett, 2005; Evans, 2006). Once the structure is provided, professors become moderators of the wiki rather than supervisors (Farabaugh, 2007; Mitchell, 2003; Wheeler, Yeomans, & Wheeler, 2008). To assist in moderating the wiki, professors can elect to receive e-mails every time the wiki content is edited. They can track these e-mail messages to confirm that all of the students are participating, to determine if students are editing existing content or adding new content, and to determine how much content individual students are contributing. Disproportionately low contributions by some students is referred to as social loafing; however, students who are logging in to the wiki and lurking rather than contributing may still be learning (Wheeler et al.). Autonomy and a clear organizational structure allow students to take ownership of the wiki and contribute personally meaningful content.

Technology Concerns

Users share control of the flexible wiki environment, which fosters the development of collaborative online projects (Engstrom & Jewett, 2005; Jakes, 2006; Robinson, 2006). Wiki software enables users to easily and quickly edit Web pages using their Web browser; they do not need any specialized technical knowledge. The wiki software's editing and graphics tools are basic compared to today's complex and ambitious desktop publishing tools. Settings and preferences are limited; at times what is displayed when editing the page is not the same as what is displayed once the page edits are saved. For example, uniform indentations and line spaces may not be uniform once the page is saved. Al- though the wiki software is easy to use, students with older equipment, those who do not have easy access to the Internet, or those whose only computer access is on campus find that contributing to the wiki is burdensome (Farabaugh, 2007).

Editing the wiki pages can be open to the public or limited to a select group of users with a password, although only one user at a time can edit a page. As users contribute to the pages, unintentional edits, such as

accidentally deleting others' words, occur, and inaccuracies appear. Just as contributors collaborate to add to the pages, they collaborate to reconstruct and correct them (Bold, 2006). Also, wikis track the revisions made to the pages and allow users to revert to previous versions (Robinson, 2006). Users can track and compare additions, deletions, and changes to the pages. Tracking changes in the wiki pages over time provides insight into students' collaborations, reflections, and learning.

To prepare preservice teachers to use Web 2.0 applications in their future classrooms, they need opportunities to learn to use the applications and opportunities to use the applications as they learn (Mitchell, 2003; Oliver, 2007; Wassell & Crouch, 2008). Luce-Kapler (2007) calls for teaching that engages students in the processes of learning content while learning new technologies, such as wikis. Further, Mitchell (2003) sees the need for additional research that examines ways preservice teachers can use technology for learning and critique the technology as they use it. Carr, Morrison, Cox, and Deacon (2007), Evans (2006), and Grant (2006) note the need for additional research focusing on the uses of wikis in education, particularly when instructors assign and assess specific collaborative tasks.

THEORETICAL FRAMEWORK

To integrate technology into preservice teacher training, the professor asked preservice teachers to create a class wiki and to learn how to use the technology as they learned the course content. This study examines how preservice teachers' contributions to a class wiki situated their learning in a context that facilitated their understanding and learning of the course content. This section defines situated cognition, constructivism, and communities of practice. It seeks to explain how participating in the wiki enabled students to construct their own knowledge as they participated in a community of practice. Additionally, it connects these theories with previous research on the benefits of wikis.

Situated Cognition

Situated cognition recognizes that social and physical contexts are integral components of learning (Brown, Collins, & Duguid, 1989; Hur & Brush, 2009). For learners to fully understand concepts, they must learn and use them in the social and physical contexts in which they are embedded (Brown et al.). Situating the learning in context ensures that the learning is memorable and can be transferred to other activities. Further, Brown et al. contend that when learners work in groups to solve problems and negotiate understanding, the cognitive burden is distributed throughout the environment. Thus, "… situated cognition implies that the activities of person and environment are parts of a mutually constructed whole" (Hung & Der-Thang, 2001, p. 4). Students' collaborative contributions to the wiki demonstrate to them that their collective knowledge is greater than their individual knowledge, and that by working together they are creating new knowledge (Evans, 2006; Grant, 2006).

Constructivism

Constructivism holds that learners actively construct knowledge by interpreting new knowledge based on their prior knowledge (Kuiper & Volman, 2008). Constructivist approaches to learning provide students with opportunities to participate in authentic activities that require them to interact with their environment and create their own understanding (Jonassen, Carr, & Yueh, 1998).Constructivist teaching moves students beyond just the accumulation of knowledge; it involves them in critically thinking, reflecting, and using the knowledge (Tynjal, 1998). In constructivist classrooms, students have opportunities to learn through social, collaborative activities that occur in a meaningful context and allow them to make connections between their prior experiences and their new experiences (Willis, Stephens, & Matthew, 1996). In these learner-centered classrooms, teachers take on the role of facilitators who guide students as they explore their environment and construct their own knowledge. Just as teachers are facilitators in their classrooms, they also become facilitators of the wiki to allow students to create their own knowledge (Farabaugh, 2007; Mitchell, 2003; Wheeler et al., 2008). Socioconstructivist theories hold that learning is socially constructed by "competent participation in the discourse, norms, and practices associated with particular communities of practice" (Kuiper & Volman, 2008, p. 244).

Communities of Practice

As students create and share knowledge in the wiki environment, they participate in communities of practice where the process and the product are equally important (Carr et al, 2007). In communities of practice, learners collaborate as they pursue a common goal (Wenger, 1997). Commitment to a common goal enables members of the communities to work together and to learn from each other as they acquire a shared understanding (Wenger). With Web-based systems, these communities of practice are not constrained by classroom walls and can be situated in various learning contexts (Hung & Der-Thang, 2001). Palmer (1997) suggests that teachers form learning communities around the subject they are teaching by presenting students with critical data to examine and the space in which to examine the data. Wikis are one example of a shared space where students come together as communities of learners to examine a subject. Community members create and share knowledge as they generate content for the wiki pages (Wheeler et al., 2008); hence, the wiki becomes an online repository of shared knowledge (Sheehy, 2008).

To summarize, wikis have the potential to enhance students' learning because wikis situate learning in an authentic context, ensuring that the learning is both memorable and transferable. Wikis provide students with spaces in which to construct their own knowledge within a community of learners who share common goals.

Purpose of the Study

The review of literature explains how wikis situate learning as they facilitate students' knowledge construction while participating in a community of practice. Wikis have the potential to provide structure and support for students as they collaborate, create, and learn from one another; hence, there is a need for ongoing research on the inclusion of wikis in classrooms (Grant, 2006). Consequently, this study is part of an ongoing research project to determine the potential of a class wiki to enhance preservice teachers' learning of course content. The following research questions guided this study:

1. How did contributing to a class wiki affect students' learning of the course content?
2. What were students' perceptions of contributing to a class wiki?
3. What technology concerns arose when using a wiki?

METHOD

The researchers used case-study methodology to examine the benefits and challenges of contributing to a wiki in a language arts methods class. According to Bogdan and Biklen (1998), a case study is a "detailed examination of one setting or a single subject, a single depository of documents, or one particular event" (p. 54). A case study is situated in authentic contexts that provide insight into complex events and environments. The researchers selected case-study methodology for this study, as the wiki was situated in an authentic learning environment involving complex events.

Participants and Procedure

The 37 participants were preservice teachers enrolled in three language arts methods classes taught by the first author. Two sections of the class were taught in a spring semester, and one section was taught the following fall semester. The majority of the students (35) were undergraduates; however, two were graduate students. These classes were field-based at an elementary school in southeast Houston. Demographic information is routinely collected at the beginning of field-based classes, and students are asked to self-identify their gender and ethnicity. There were 3 male students and 34 female students. Ethnic backgrounds included 20 Caucasians, 14 Hispanics or Latinos, one Asian, one Asian-American, and one African-American. To assist in gathering data for this study, students were asked to indicate the year they were born; participants ranged in age from 20 to 47 years of age.

Participation in the wiki was a class requirement, and students' contributions to the wiki were part of the course assessment. However, students were given the option of not having their reflections included in the study. Students were asked to sign consent forms if they agreed to have their reflections included in the study. The consent forms were placed in a sealed envelope that was given to the professor's secretary, and professor did not open the envelope until after submitting the grades for the course.

As part of the course requirements, students added course content to a class wiki housed on PeanutButter Wiki at http://llls4434.pbwiki.com. The wiki consisted of 40 pages, including an introductory front page, a table of contents page, 11 pages covering course content, and a 26-page dictionary. The course content pages include (a) oral language, (b) phonological and phonemic awareness, (c) alphabetic principal, (d) literacy development and practice, (e) word analysis and decoding, (f) reading fluency, (g) reading comprehension, (h) development of written communication, (i) writing conventions, (j) assessment and instruction of developing literacy, and (k) viewing and representing. These page headings align with the Texas English Language Arts and Reading Educator Standards (SBEC, 2002) and the National Council of Teachers of English/ International Reading Association Standards for the English Language Arts (NCTE/IRA, 1996), which serve as a framework for the course content. Each wiki page contained a sidebar with links to the other pages to facilitate navigation through the site.

Prior to the first class meeting, the professor e-mailed preservice teachers an invitation to visit the wiki and provided the password for logging into the wiki. During the first class meeting, the professor explained the project to the students and introduced the wiki as an easily accessible online environment for them to create a shared knowledge of the course content. Additionally, although the professor received e-mails when students made edits and periodically reviewed the wiki pages, she did not make edits to the pages or offer comments on the pages. The professor's stance as an observer ensured that the students had autonomy regarding the content of the wiki.

These classes met at a local elementary school where district policy prevented the class from having Internet access during the spring semester. By the fall semester, Internet access was granted; however, the district's Internet blocking software did not allow access to the wiki. Hence, the introduction to the wiki consisted of screen shots of the pages in a PowerPoint presentation. The professor gave students a handout with screenshots and step-by-step instructions for adding a definition to the dictionary pages of the wiki. This introductory assignment was designed to give them practice in adding content to the wiki and to help them overcome any anxiety they might have about contributing to the wiki. The professor had sent invitations to join the wiki to the students through their university e-mail accounts, which some students do not check on a regular basis. After the introduction, the professor collected students' preferred e-mail addresses and sent invitations to those e-mail accounts.

The preservice teachers formed groups with two or three members, and then each group selected a wiki page that they would monitor throughout the semester. Each group's responsibilities included deleting inappropriate or inaccurate content, adding links to Web pages related to the topic, adding links to other wiki pages, adding dictionary entries that pertained to their wiki page, and formatting the page. During the last week of class, each group was responsible for making final additions and edits to their wiki page.

Throughout the semester, the preservice teachers were required to add course content to the wiki pages. The course syllabus indicated which assigned readings corresponded to each wiki page. After reading the assigned textbook pages, discussing the course content, completing in-class activities, and tutoring elementary students at their field-based placement, the preservice teachers were to share what they learned with their classmates by contributing to the class wiki. These contributions could be in the form of adding content to already existing pages or adding new pages to the wiki. Students were told that postings might include summaries of what they read in the textbook, connections between their textbooks and their personal experiences of learning to read and to write, questions about teaching reading and language arts, connections between their field experiences and the course content, and connections between their professional development activities and the course content. The professor established three checkpoints during the semester at which time she required students to post about their wiki use in their personal folders in WebCT course management software. These posts included brief descriptions of their edits and additions to the wiki pages, as well as a reflection on their experiences contributing to the wiki. Students also used WebCT to record their field-based experience journals and e-mail communication, and the professor used it to post class handouts and resources.

Data Collection and Analysis

Data collection included online observations of the development of the wiki pages, students' reflections periodically posted in WebCT, final reflections, e-mail correspondence, interview transcripts, and researcher notes. At the end of the first semester, the researchers randomly selected five students to participate in interviews about their experiences contributing to the wiki pages. The researchers designed the interview questions to elicit additional comments from the students regarding their participation in the wiki and to confirm information found in the reflections. Interview questions are included at the end of the article (see Appendix).

The second author, a graduate research assistant, conducted the interviews. The researchers analyzed the data using the constant comparative method (Glasser & Strauss, 1967). Relationships identified through analysis of initial observations and discussions were continually refined through the data collection and analysis process, and then continuously fed back into the process of category coding. Categories began to emerge through constant comparison of episodes (Merriam, 1988). NVivo 8 software facilitated data analysis. Theresearchers transcribed and entered the interviews into NVivo, along with all digitally recorded data sources. The researchers independently read student reflections and interview transcripts, then separately noted 23 emergent subcategories across the

data from 338 data sources containing 562 references. NVivo calculated interrater reliability (Kappa coefficient) based on the percentage agreement of the coding queries performed by the two coders, the first and second authors. Interrater reliability was .88; coding discrepancies resulted from differences in the lengths of the strings marked in NVivo. The researchers discussed and resolved all discrepancies.

RESULTS

The data analysis revealed themes and categories that addressed the original research questions:

1. How did contributing to a class wiki affect students' learning of the course content?
2. What were students' perceptions of contributing to a class wiki?
3. What technology concerns arose when using a wiki?

The impact on students' learning was evidenced by their reflections on the benefits of reading and rereading the wiki pages and by the connections they made between their prior knowledge, prior experiences, and new learning. Regarding students' perceptions of the wiki, they noted that it was personally useful, they established ownership of the wiki, and they could foresee ways to use the wiki. Initial technology concerns and problems lessened as students grew accustomed to using the wiki software; however, technology concerns remained. A detailed analysis of the results follows, including information on lessons learned from the students' suggestions regarding changes in the wiki assignment.

Impact on Students' Learning

As students contributed to the wiki pages, their reflections on the process and their interview comments revealed that they spent time reading and rereading the pages. As they researched content to add to the pages, they made connections to their prior knowledge and experiences, to the content they were learning in other classes, to their tutoring sessions with elementary students, and to a variety of Internet resources.

Reading and rereading. Unlike individual writing assignments, posting to the wiki pages required students to be cognizant of their peers' contributions. Students' online reflections and interview comments indicated that they were continually reading and rereading their classmates' postings in order to add new and relevant information while avoiding redundancy, knowing that the content, quality, and the usefulness of the wiki was in their control. As one commented, "So as not to post duplicate information on each wiki page, I was forced to read through each and every bit of information on a page before researching and posting to it." Some students noted that, as the semester progressed and the wiki pages grew longer, there was more material to read through. This meant that, to avoid reposting information already on the pages, the students invested more time and effort in learning and researching the course content to find new material to post. One student noted that this was a good thing: "I like these later postings, as I had to read every posting again to make sure nothing is duplicated." These reflections about rereading to avoid duplicating information on the wiki also indicate students' ownership of the wiki and their concern about the content on the pages. Continually reading and rereading the wiki pages led to a deeper understanding of the course content and enhanced retention of the material.

Reading and rereading the wiki pages resulted in students building on each others' work, as one student reflected: "Someone had already named some good strategies to improve reading comprehension. I found some more in the textbook, so I listed them underneath." In this instance, she just contributed to the already created list and did not extend the material. In another post, she noted, "Someone had already given a good example of how oral language develops, so I found some fun activities on the Internet that help develop oral language." She advanced the group's collective knowledge by adding activities to teach the skill, which provided her classmates with a way to apply this knowledge in teaching situations. Thus, the information posed by one student served as a foundation for another student to build on and to enhance the collective knowledge of the community of learners.

Not only were students reading and rereading the wiki pages, they also reported careful reading of the course textbooks. Their quests for relevant material to contribute to the wiki led them to read and reflect on the content in their textbooks. As one student wrote, "I enjoyed this assignment because it forced me to jump into the textbook in a way that I would not have done on my own time." Another student reflected, "… I was forced to reread some information in the textbooks and really think about ways to elaborate on what was read." The word forced appeared in reflections and interview transcripts, indicating that, had it not been for the required wiki assignment, the students would have spent less time reading and studying their textbooks. Hence, contributing to the wiki required students to carefully read their textbooks and to synthesize what they learned. The careful reading and synthesis of the reading led one student to note, "It gave me a much better understanding of what it was I was reading versus just going through the motions of having to read the chapters." This careful reading of the textbooks persisted throughout the semester, as evidenced by this comment: "On the last post I really focused on content and dug into the textbook and found a lot of information." As students read, they compared and contrasted the information in their textbooks and on the wiki pages to ensure that they understood the material in order to add meaningful content to the wiki. This comparing and contrasting of information from different sources "…gives me a better understanding of the material and embeds it into my memory," wrote one student.

Connections. In 39% of the sources, almost one fourth (23.6%) of all coded references note or reflect on the types of connections the students made while taking the class: activities outside the confines of this course, their own teaching practice, materials found online, and textbooks from this course as well as from other courses. In their searches for content for the wiki pages, students looked for connections within the materials posted on the wiki pages, as well as across textbooks, online information, class discussions, class activities, their tutoring sessions with elementary students, and other classes in their teacher preparation program. Approximately 10% of the sources reference textbooks used in classes, and more than 50% of the textbook comments and reflections referenced textbooks from other classes. The students were clearly reaching beyond the confines of their assigned materials and making connections with what they were studying in other classes. As they learned the course content, they were building on their prior knowledge to aid them in understanding their new knowledge. Or as one student noted, "I could actually relate what I already knew and maybe even things I didn't realize I knew and put them in context."

During an interview, one student mentioned her efforts to find new information to add to the wiki pages. She reported using her previous textbooks and Internet searches to find information her classmates might not find. Wanting to find information that others had not found, and needing to find information not contained in the textbooks, led students to Internet searches. For example, writing conventions was the focus of a standard and the title of a wiki page; however, the course textbooks did not define that term. To contribute to that page, a student did an Internet search and then added the definition of the term

to the wiki. She wrote, "I provided the information of what a writing convention is. I could not find anything about it in the text, so I found a good definition online."

Internet searches revealed not only new information and definitions, they also enabled the preservice teachers to find activities for teaching students. One successful Internet search prompted this reflection: "I was really excited to find so many activities you do to help students that are struggling with specific reading and writing techniques." Many added external links to Web pages with descriptions of what could be found on them. Some added content from the Web sites and included a link to the Web site as a citation.

Weekly tutoring sessions with students in the elementary school where the class is field-based began during the fifth week of class. These sessions give the preservice teachers opportunities to immediately apply the information they are learning in the course. Encounters with struggling elementary students led the preservice teachers to the wiki to search for ways to help the students. After finding ideas on the wiki, a student posted, "I was really excited to find so many activities you could do to help students that are struggling with specific reading and writing techniques." The wiki pages became a resource for their tutoring sessions, as evidenced in this comment: "I like how each wiki page gives activities to use when teaching; this is a very useful tool and resource." Preservice teachers typically enroll in more than one field-based class each semester and tutor students in each of these classes. One preservice teacher noted how the wiki helped her prepare for tutoring in another field-based class: "I enjoyed this activity because I am currently working with a second grade student for another class, and he has been held back once and is struggling again this year. I looked up areas I know that he is weak in so that I could not only complete the wiki assignment but also gain insight on how I can help him develop stronger skills." Being able to use the wiki in more than one class showed the students how their courses build on one another and that their courses provide them with the knowledge and skills they can use in different teaching situations. The practical application of the information from the wiki pages to their tutoring reinforced that contributing to the wiki page was beneficial.

Contributing to the wiki reinforced classroom activities and extended classroom discussions. For example, one student reflected, "We had gone over these strategies in class so I found them and put them on as a reminder. I also liked the hint that gave an idea for teachers to go back and assess each time they are with the child and follow their progress." She reinforced the course content by adding it to the wiki and extended the course content by including the idea on how to assess students in order to chart their progress.

Wiki postings were also an opportunity to explore answers to questions students posed, as evidenced by this reflection: "During the class I heard several students wondering why it was we were asked to write daily for 30 minutes on a topic of our choice, so on Standard IX [writing conventions], I added the answer to their question." Although this was not part of the conversation, this student saw the wiki as an opportunity to add to the collective knowledge of the group by reminding them why 30 minutes of writing was required during each class period. Working together as a community of learners ensured that students recognized that they were all responsible for the learning of all the members.

Preservice teachers' contributions to the wiki pages indicated that they made connections between courses in their degree program, professional development sessions, tutoring sessions, outside readings, and Internet research. Making these connections resulted in this comment: "It's amazing how each of us come up with very helpful and interesting ideas on the same subject." Students came to recognize that their classmates had unique knowledge and that, when they collaborated on the wiki, the collective knowledge of the group became a valuable resource for them all. As students added to the wiki pages, they extended their learning in this course as well as their learning in other courses by making connections between the courses. A student recognized this benefit when she wrote, "I think that the wiki pages will be very useful for studying for all of my classes because a lot of the same information is covered in my other classes." Making connections reinforced students' learning and made it memorable, thereby enhancing retention of the material and their ability to use the information in a variety of teaching contexts.

Assignments in other courses also led students to make connections between their classes. A special education class assignment provided a student with information to contribute to the wiki. She wrote, "In another class of mine we were assigned a disability and through my research for that topic, I stumbled across some, what I thought was, valuable information for language arts teachers as well." This is another example of how the students worked to find information for the wiki that they did not think their classmates would come across on their own as they worked to add to the groups' collective knowledge. Connections to other classes also resulted in students revisiting prior learning and gaining a deeper understanding of their prior learning. As one student noted, "These wiki pages provide an opportunity for me to research terms that I have heard in some classes but never really used." The student recognized that the knowledge she had of these terms was inert, and contributing to the wiki provided an opportunity to make the words a meaningful part of her knowledge base by situating them in her current learning environment.

Students' Perceptions of the Wiki

Almost one fourth of all references (132) included preservice teachers' feelings about the wiki, possible future uses of the wiki in the students' own practice, or the extent they felt the wiki was beneficial for their learning course content. Although the students noted that contributing to the wiki required a great deal of time, they also determined that it was worthwhile. During the course of the semester, the students' comments indicated that the wiki had become personally useful to them, that they assumed ownership of the wiki, and that they discovered future uses for the wiki. Their original perceptions of the wiki were that it was just another class assignment to be completed for a grade. This initial skepticism changed as they came to realize that the wiki was actually a very useful tool and was beneficial to their learning and their future teaching.

Personally useful. Contributing to the wiki pages required students to spend a great deal of time reading, researching, synthesizing, and adding content to the wiki pages. As one student reflected, "It was a challenge because you are looking for information and at the same time learning as you research." Writing content for the wiki pages required that students first understand the content. Developing this understanding was not easy, as students had to make connections between their previous knowledge and experiences and their new knowledge and experiences. As they read and researched, they synthesized what they learned, applied their learning in their tutoring sessions, and shared their learning with their classmates by contributing to the wiki. They learned that the group's collective knowledge was greater than their own, and that they could learn from each other as noted in this reflection: "When you collaborate with your peers, I feel that it is easier to come to a conclusion or express an idea." What at first was just another class assignment to complete for a grade became a valuable learning experience. For example, one student noted, "At first it seemed like a waste of time and just another way to keep us involved in busy work, but I have learned so much from it." This sentiment was echoed in another student's final reflection:

> I have learned so much from doing this assignment this semester. I think you learn more than you realize just by researching each topic. These standards we are contributing [to] are very important, and it's nice to understand them now because honestly in the beginning it was just a bunch of words to me.

This "bunch of words" was personally meaningful, and the knowledge the student gained was knowledge that she would retain and use.

Students reflected on specific personal uses for the wiki, with 13.1% (44) of the sources and 13.5% (76) of all references mentioning or reflecting on the possibility of incorporating wikis into their work. One student commented, "Our wiki pages are actually going to help me get through my internship this semester!" She was using the materials on the wiki to plan her lessons during her internship or first semester of student teaching. Individual students reported on ways they benefited from the groups' collaborative efforts. For example one student noted, "The part about the wiki pages that I found to be most useful was the dictionary. If I needed help with anything instead of looking it up in the book I just pulled up the wiki pages." Adding to the dictionary became more than an introductory assignment to the wiki pages. Another student reported in her reflections that she searched the wiki pages for words and definitions that she thought should be in the dictionary and added them. Another student also reported evidence of the dictionary's usefulness when she added to it as she encountered unfamiliar words while reading her textbook. The wiki became an integral part of their learning environment.

Just as the preservice teachers discovered ways to use the wiki pages to help them as students, they also discovered ways the wiki could help them as parents. Four students commented that resources on the wiki helped them teach their own children to read and to write. In a reflection, one mother posted that she found an activity on the wiki for motivating reluctant readers. As she was struggling to find ways to motivate her daughter to read, she decided to try out the activity. Armed with a blanket, some carefully selected picture books, and snacks, she invited her children to go outside to read and to snack. Her reluctant reader was soon reading and snacking. Students' ability to find personally meaningful content on the wiki that they could use to help themselves and to help their children contributed to the sense of ownership of the wiki.

Wiki ownership. As contributing to the wiki was a course assignment and students were assessed on their contributions, it was not surprising that 43% of all the posts (146) mentioned the edits made to the wiki pages and 47% of all references (267) discussed the types of changes the students made on the wiki site. These edits and changes reflect the care and effort that students put into the creation of the wiki pages. Giving the students autonomy on the scope and the content of the wiki facilitated their assumption of ownership. Knowing that the content and ultimately the quality and the usefulness of the wiki depended on them, students took ownership of the wiki as evidenced by comments such as: "The pages are interesting and it is fun to make something that is our own." Students recognized that, not only was the wiki theirs, but it was important: "I liked adding to the wiki pages because I felt like I had ownership over something important." Students realized that the wiki was not an assignment to be completed, turned into the teacher, and never seen nor used again. This was an assignment that resulted in something valuable that they and other students would continue to use. They knew that the wiki was going to be there for them in the future and that each semester, new groups of students would be contributing content. As one reflected, "When you work hard on something and collaborate with others you want to see how it progresses and changes, and I know I want to see how others add to this project." Their pride in ownership resulted in students telling students in other classes about their creation of a wiki: "I have told others about the wiki pages we worked on for our class and everyone thinks it [is] amazing that we were able to do it." Valuing students' knowledge, giving them a framework for the wiki, and allowing them autonomy for devel- oping the wiki resulted in students taking ownership of the wiki.

Future uses. Although there are relatively few responses, 2.4% (8) of the sources and 1.8% (10) of all references discuss concrete ideas for future use of a wiki; the large number of responses in the Personally Useful and Ownership categories show that the motivation and technical skills are present for these preservice teachers to integrate wikis into their teaching. One student, mindful that she was a member of a community of learners, noted in her reflection not only future benefits for herself, but also future benefits for her classmates when she wrote, "Not only does this information help me to prepare for bilingual education teaching challenges, but it also gives general education teachers tips on how to better serve ELL students they will have in their classrooms." These preservice teachers were making the transition from student to teacher as they recognized that the wiki contained information they would need in their future classrooms. This transition was further evidenced by reflections such as "… reading through the pages is very beneficial for a future teacher" and "… I found very interesting information that will help me in my future classroom."

Students' contributions to the wiki and their reflections showed that, over the course of the semester, they came to see themselves as teachers. Whereas it is expected that students make this transition during their field-based courses, their reflections on their contributions to the wiki provided evidence that this indeed was happening.

Five preservice teachers considered ways they could use a wiki with their future students. One posted, "I hope to eventually teach upper level grades and have a wiki page or a class website." A second preservice teacher saw a wiki as a resource for students and their parents as evidenced in this reflection, "I love the idea of a wiki and will try to perhaps start and maintain a wiki page for my students and their parents." Collaborating to create the wiki taught the preservice teachers to use technology as they learned course content, and this student's posting indicates that she was ready to use her skills in her future classroom. Another preservice teacher envisioned having her middle school students create a wiki. She posted, "They could have a group and pick a topic and the teacher could help them start their own wiki." She not only envisioned this, she was also making plans to implement a wiki in her classroom.

Using the wiki to learn course content gave the preservice teachers ideas for how to integrate technology into their own teaching. Most important, the wiki demonstrated to the preservice teachers the value of allowing their students to collaborate to construct a shared knowledge. They came to understand that meaningful, authentic class assignments requiring collaboration resulted in deep learning. As one student reflected, "The wiki pages were an interesting way to learn the concepts because I did not realize that I was actually learning without studying the book."

Students' Technology Concerns

Advanced technology skills were not required for editing the wiki page, and the same skills that students used in word-processing documents transferred to editing the wiki pages. However, 10% of all references (56) explained the technology difficulties students encountered while working on the wiki. These included complaints about not being able to log into the wiki, not knowing how to enable cookies, not having prior experiences working on shared documents, not being familiar with the refresh button, and deleting the content of entire pages.

Students' technology concerns revealed that some of them lacked technology skills it was assumed they had already acquired, such as enabling cookies, working on shared documents, and clicking the refresh button in their Web browser. Editing the wiki pages required that students have cookies enabled in their Web browsers, and three students reported receiving error messages about not having cookies enabled. For example, one student e-mailed, "I am having problems signing on to the wiki pages. When I enter the password and my name, the computer says the cookies on this computer are disabled." With instructions from the professor, two students enabled cookies on their home computers, and one student brought her laptop computer to class for the instructor to walk her through the process. During the first semester the wiki was used, two students reported during class that they could not edit a wiki page because someone else was currently working on the page. Realizing that students did not have previous experiences with sharing documents over the Web, class discussions ensued explaining why only one person at a time could make edits to the pages. Students realized that they should not wait until

the last minute to make edits, as access to a page might not be available. Another difficulty arose when students edited their pages, clicked save, and received an error message. When this was mentioned in class, other students responded that this had happened to them and that the solution was to click the refresh button in their Web browser. Sharing their technology concerns in class led students to realize that their classmates were resources to turn to when they encountered problems. This realization resulted in students immediately posting in WebCT for assistance from their classmates when they encountered technology challenges. They recognized that, as they belonged to a community of learners, the collective knowledge of the group was available to them all.

During the second semester, the introduction to the wiki included information on enabling cookies, sharing documents, and clicking the refresh button. Students' inability to enable cookies, lack of experience with sharing documents over the Web, and not knowing to click the refresh button suggested that perhaps they had not taken the required technology course. However, unofficial transcripts showed that all of the students in the classes had recently taken the technology course and received either an A or a B. Although the technology course required that they use Web browsers and complete assignments on the Web, for some students this learning was not memorable and was not transferred to this new situation, the class wiki. Some preservice teachers' inability to transfer their technology skills to the wiki indicates how important it is that they have technology integrated into all of the courses in their degree program if they are going to successfully integrate technology into their own classrooms.

One student, who reported having taken several technology classes and reported using technology in her job, noted seven technology concerns in her reflections. This student was among those randomly selected to participate in an interview, in which she stated that she considered herself an experienced technology user and reiterated her concerns about the limitations of the wiki software. For example, she stated, "I noticed the font I see on the edit page and the actual font applied after save were different. Obviously, this is a bit frustrating and the preview page should display the correct format." Another student posted five reflections indicating problems with the technology. This student was the oldest student in the group and the most willing to try new things. She was the only student who added new pages to the wiki and was one of the students who deleted the contents of an entire page of the wiki. It seems that contributing to the wiki was most challenging for the technology-savvy student and the most adventurous student. When specifically asked about technology concerns during the interviews, only one additional student reported problems. Although students may have had technology concerns they did not report, it seems that overall the wiki software was easy for the students to use.

Accidentally deleting the contents of entire pages was a persistent problem over the two semesters, and it occurred twice each semester. Panicked calls and e-mails to the instructor and pleading posts on the discussion board of WebCT for help from their classmates followed these disastrous events. The introduction to the wiki included information on how the wiki tracked their edits and allowed the instructor to delete unwanted edits, including those that deleted the contents of a wiki page. Additionally, the instructor reassured the students that if they deleted the contents of a page, she would refer back to the e-mails that were sent after each page edit and determine who had contributed to the page. This information was not meaningful to the students until they accidentally deleted all of a page's content and discovered that clicking the refresh button or logging out of the wiki and logging back in would not restore the content. In all four disasters, deleting the last edit restored the page; however, the successful restoration of content did not ease all of the students' fears about making changes to the pages. Even though students were required during the last week of class to edit and format their pages, some resisted, and as one noted, "I was tempted to change all the text on the wiki page to match the same size, font, and color, but was afraid to wipe out any of the information." Hence, not all of the wiki pages had final edits completed at the end of each semester, as students found it difficult to edit each other's work, in part because of a lingering fear that they would delete the entire contents of a page.

Although technology problems persisted throughout the semester, students had ample opportunities and successes in adding and manipulating content. This was evidenced by the fact that 40% (136) of the sources and 44.3% (249) of all references discuss activities, content, definitions, internal and external links, new pages, and visuals added to the wiki. Additionally, after overcoming initial technology problems, completing the dictionary assignment, and periodically making posts to the wiki, students' comments reflected a growing ease with using the wiki. One student noted, "Editing the third wiki reflection was even easier than my last one. I felt really comfortable adding to them." Another student reflected, "In my experience with contributing to the wiki, I found that entering content was easier than I expected. I was nervous about entering the wrong information, entering things that others might not agree with, or deleting something on accident." Although this student began to feel more confident in her ability to use the wiki software, she had lingering concerns about others critiquing her posts and accidentally deleting content from the wiki. Additional experiences contributing to Web 2.0 technologies such as wikis and blogs will perhaps make students more comfortable with posting information on the Web that others might critique or change. Additional opportunities to use Web 2.0 technologies will also provide students with the skills and confidence they need to use them effectively.

Lessons Learned

Preservice teachers' suggestions for ways to improve the class wiki assignment included assigning roles within the groups, so that the group members would not be redoing and undoing each other's final edits to the pages. They also suggested assigning different levels of access to the pages to prevent changes to their pages during the last week of class, when final edits were due. This would prevent their classmates from going in during the last week of class and adding additional content that frequently resulted in changes to the formatting and necessitated additional checking for accuracy of content. However, the software used for this wiki does not allow for assigning levels of access to individual pages. The preservice teachers expressed concerns about the veracity of the Internet sites that their classmates referenced and concerns about the accuracy of the content posted on the wiki pages. They also expressed concerns about content from books that students had not properly referenced and content that students had copied and pasted from Internet sites. A reference section was placed at the bottom of each page to include bibliographic information for books cited on the page. The professor instructed group members to delete any information that had been copied and pasted directly from other Web sites. The preservice teachers' suggestions for improvements focused on their roles as contributors and their responsibility for the quality of the content, which reflects their feelings of ownership of the wiki.

DISCUSSION

Contributing to the class wiki required students to collaborate as they created shared knowledge that enhanced the collective knowledge of the group. As students read and reread the wiki pages, they developed an appreciation of their classmates' knowledge and recognized it as a valuable resource, as noted by Hewitt and Scardamalia (1998) and Parker and Chao (2007). To contribute to the wiki pages, students first had to understand what their classmates knew and then research to find new information that would build on what their classmates wrote. Building on each other's work required the preservice teachers to be actively involved in the creation of a collaborative product (Dearstyne, 2007; Richardson, 2006); this required them to compare and contrast what was already posted on the wiki with the content they found in their course textbooks, textbooks from other courses, and Internet sites. Comparing and contrasting the information from diverse sources led to deeper processing of the material, which confirms research by Mayer (2002). Using text-

books from other classes, as well as assignments from other classes, produced a synergy (Achterman, 2006) that enhanced classmates' understanding of the course content.

The preservice teachers perceived the wiki as personally useful for them as students, as parents, and as future teachers. The wiki was not just another class assignment to be completed for a grade; it became a collaborative endeavor that contained the collective knowledge of the group that benefited them all. Finding it personally useful led students to assume ownership of the wiki and to make it their personal repository of information. As one student noted, "The wiki pages were exceedingly useful for me. These collaborative pages of our work helped me to better understand the textbook, the lectures in class, also including my tutoring sessions and even on some of my other classes."

Wikis, as with other Web 2.0 applications, are relatively easy to use and deploy. Although the preservice teachers had persistent technology problems with the wiki software, its ease of use enabled them to focus on learning the course content rather than on learning to use a new technology. As advocated by Mitchell (2003), Oliver (2007), and Wassell and Crouch (2008) these students learned to use the application as they learned the course content. However, for students with limited access to computers and limited access to the Internet, contributing to the wiki was burdensome, as also noted by Farabaugh (2007).

Web 2.0 applications, such as wikis, require students to actively participate in the creation of knowledge rather than passively absorbing knowledge (Wells, 1999). The collaborative knowledge creation resulted in the preservice teachers deeply processing and learning the material. Further, they combined knowledge gained from other teacher preparation courses with the new knowledge gained in their language arts methods class, which resulted in a deeper learning of the course content and a rich understanding of the connections between their courses. As one student summed up her participation in the wiki, "It was fun being a part of something so innovating [sic] and different."

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Appendix

Interview Questions

1. How did you prepare for posting on the wiki pages?
   Probe questions: Did you read the wiki pages before you posted? What impact did this have on your learning? What did you do before you posted on the wiki pages?

2. How did your group decide what changes to make on your wiki page?

3. What resources did you use as you searched for content to add to the wiki pages?

4. Can you tell me about any connections you were able to make between LLLS 4434 and other courses you have taken?

5. How did adding to the wiki pages impact your learning the course content?

6. Can you tell me about a time when you were able to use or apply information that others had posted on the wiki pages?

7. How would you use a wiki in the future?
   Probe questions: Do you have any ideas on other ways a wiki could be used? What do you think are the long-term benefits of using this wiki?

8. How are they different from other collaborative projects you have participated in?
   Probe question: What are the drawbacks of using a wiki?

9. Did you have any experience editing electronic/online documents prior to attending this class?
   Probe questions: How was editing the wiki pages different from other types of editing you have done on electronic documents (for example, other Web pages or class assignments?

10. When you were working on the wiki pages did you encounter any technical problems?
    Probe question: Can you tell me about them?

11. What kinds of edits did you make to other students' postings on the wiki pages?